



A Stitch in Time Saves Nine

Program diagnostics using the Rayleigh model for executive decision-makers (generic brief)

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Research Task: Questions to Be Addressed

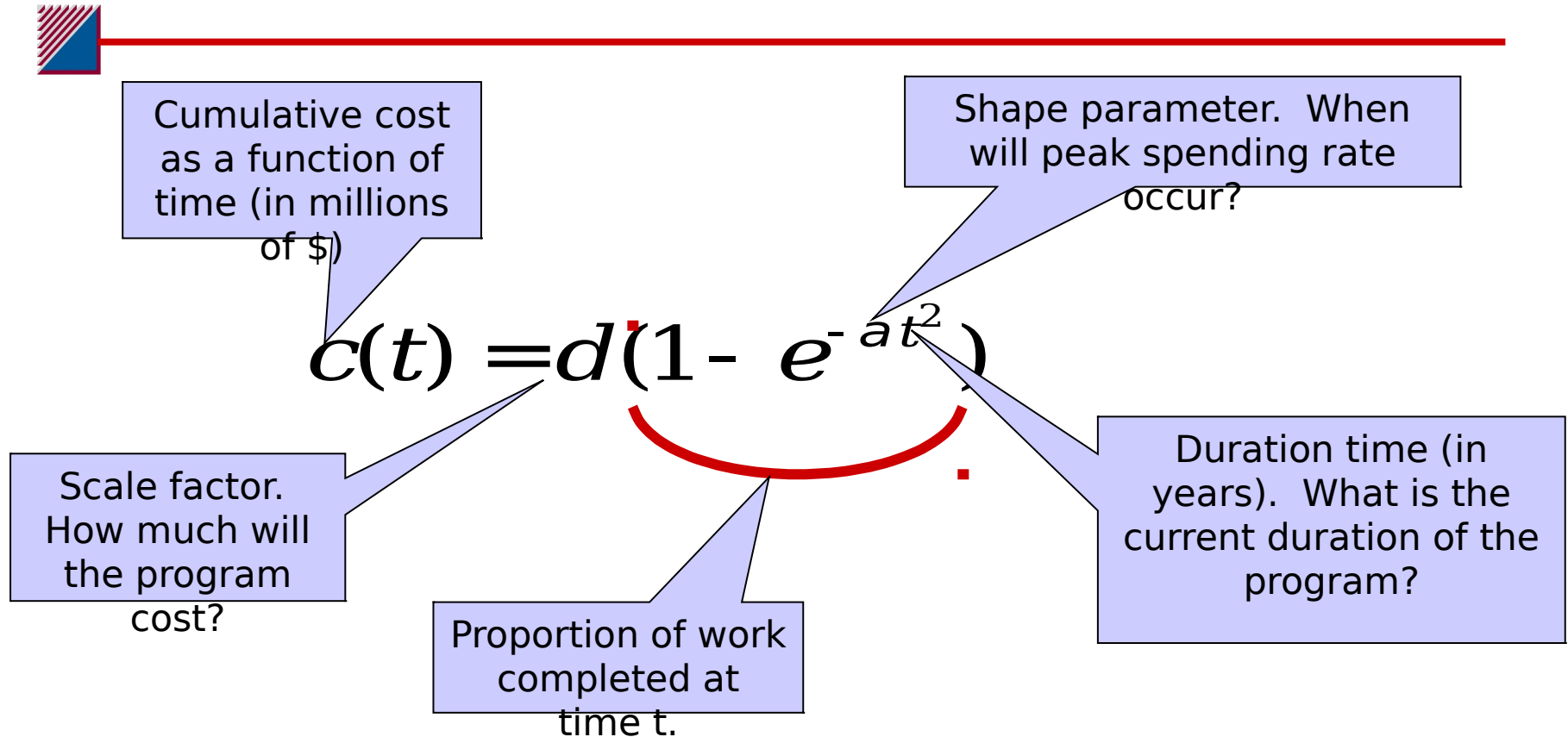
- How can an executive effectively use questionable EVM data for management decisions?
- Can new tools be developed or “old” tools modified to give earlier warning of impending contract execution problems?

Briefing Agenda

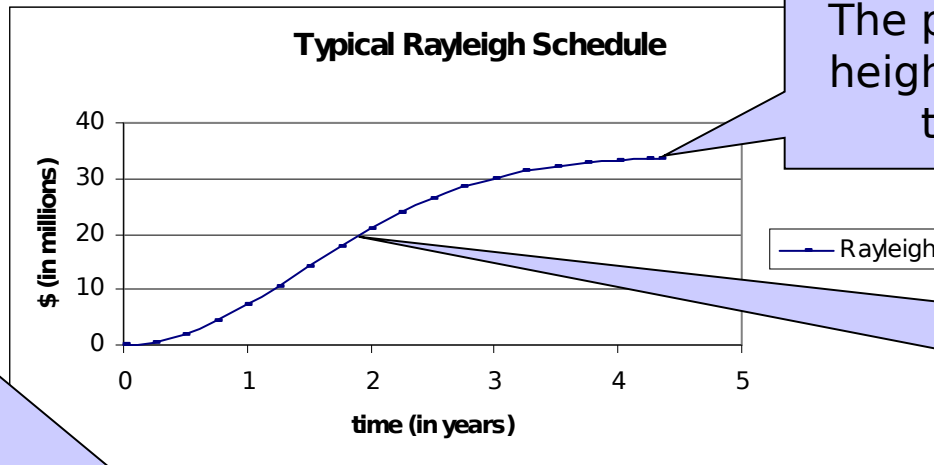


- Summarize Rayleigh model
- Summarize results of validation
- Demonstrate tool
 - One module for “traditional” analysis
 - One module for assessment of an original plan before actual cost data has been collected
- Potential Impact of study
- Potential for future work
- Recommendations

The Rayleigh Model



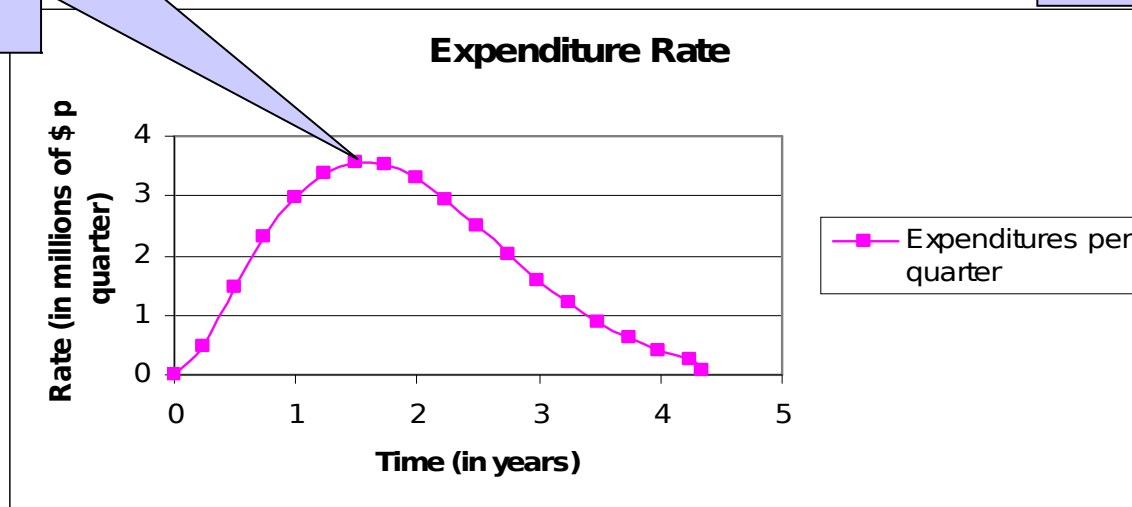
An Example of a Rayleigh Schedule



The parameter d tells us the height of the curve. What is the upper bound on cumulative cost?

The parameter α tells us the shape of the curve. When does the peak spending rate occur?

This curve inflects when the rate curve below reaches a maximum.



Rayleigh Model

Advantages

- Rayleigh is a plausible model of cumulative cost accrual over the life of a contract
- The model is based on current (then-year) dollars
- The model depends only on standard currently available EVM data (no new reports)
- The model only requires 3 actual cost submissions and a budget

Rayleigh Model

Advantages

- The model does not depend on the reliability of Earned Value (BCWP) submissions
- The model predicts both EAC and completion date
- The model predicts the path of actuals to completion date
- The model is Excel-based using standard Solver add-in

Validation of the Rayleigh model

- Compared accuracy of predictions considering cost at completion and completion time
- Methods compared
 - Rayleigh estimate
 - Contractor estimate
 - PM Estimate

Validation (cont)



- Methods compared (cont)
 - EAC1 (BAC/CPI plus max of contractor and PM time estimate)
 - EAC 2 ($Actuals + (BAC - EV) / (.8CPI + .2SPI)$ plus max of contractor and PM time estimate)
 - EAC 3 ($Actuals + (BAC - EV) / (CPI \times SPI)$ plus max of contractor and PM time estimate)
 - Note: EAC1, EAC2, and EAC3 methods do not produce an independent estimate of duration time

Validation (cont)



- Selected programs for regression analyses
- Selected only R&D programs
- Selected complete programs
 - Eliminated programs less than 90% complete to get valid baselines
 - Eliminated programs with over 2 years between work start and first submission to evaluate early warning utility

Validation (cont)

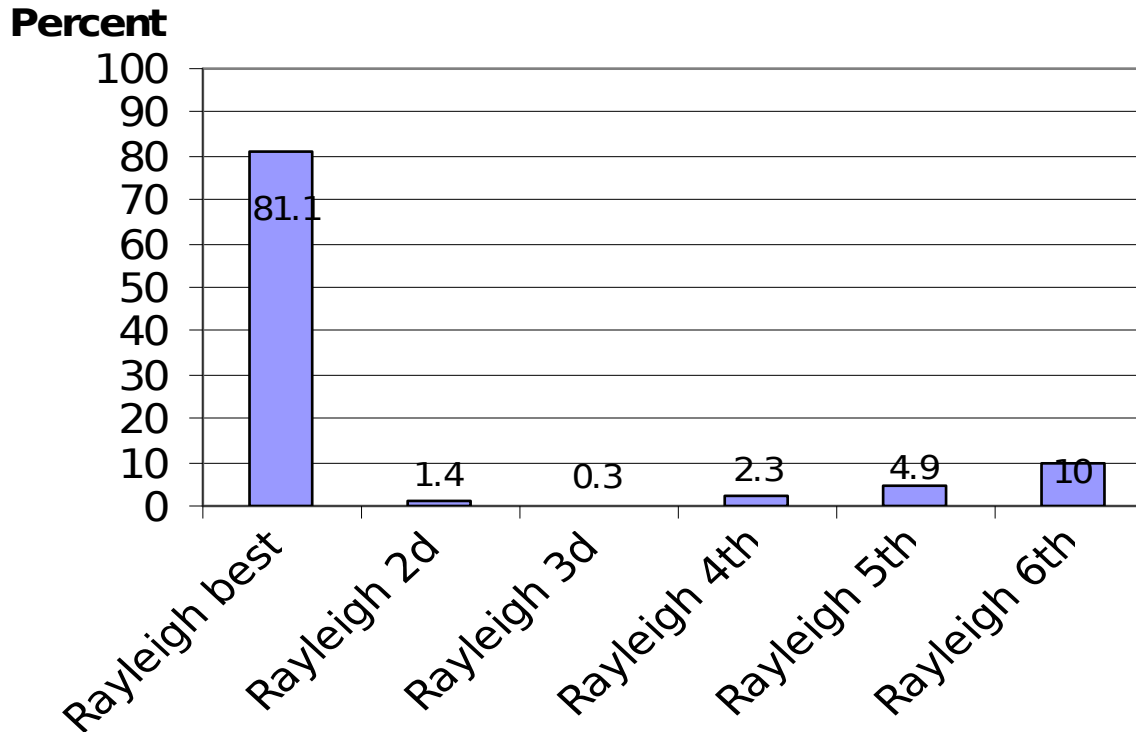


- Began with entire CAS database
- Selected 74 programs
- Consisting of 115 contracts
- Earliest start date 1/1/1970
- Latest start date 8/1/2002
- All services included

Rayleigh validation results



Rayleigh Composite Accuracy Ranking



How much better were Rayleigh predictions?



- All estimates underestimate final cost over 78% of the time. When they underestimate cost:
 - Rayleigh underestimates final cost on average by 30%
 - The contractor underestimates on average by 35%
 - The PM underestimates on average by 37%
 - The EAC1 method underestimates on average by 34%
 - The EAC2 method underestimates on average by 34%
 - The EAC3 method underestimates on average by 32%

How much better were Rayleigh predictions? (time)

- All estimates underestimate final contract duration over 73% of the time. When they underestimate duration :
 - Rayleigh underestimates duration on average by 24%
 - The contractor underestimates on average by 35%
 - The PM underestimates on average by 55%

Conclusions from database validation



- Rayleigh yields best estimate of final cost
- Rayleigh yields best estimate of time duration

Conclusions from database validation

(cont)

- Rayleigh is still short of final cost on average by 30%
- A basic assumption of all EAC techniques is that we know full scope at the time of prediction and we fit the sparse data with a single Rayleigh curve
- Earlier CNA study (“Program Cost Growth: The Navy’s Experience 1983-2004”)
 - Total cost growth is level from 1978-2004
 - Within the total, the “overrun” component is declining and the “changes” component is increasing
- We think the bulk of the 30% shortfall is attributable to contract changes

Executive Cost and Schedule Assessment (XCaSA) tool

- Executive Plan Assessment Module (XPAM)
 - Allows executive to assess plan realism before any actuals are submitted
- Executive Contract Assessment Module (XCAM)
 - Allows executive to assess contract performance after at least 3 submissions of actuals

XCaSA (cont)



- XCAM (cont)
 - Incorporates Rayleigh estimates
 - Displays “traditional” analysis for comparison
 - Incorporates relevant DCMA tripwires

New metrics (XCAM)



- Cost Overrun Vulnerability

Index:
$$COVI = \frac{EAC_{Rayleigh}}{BAC_N}$$

- Schedule Slip Vulnerability

Index:
$$SSVI = \frac{t_{Rayleigh}}{t_{N,PM}}$$

New features (XPAM)



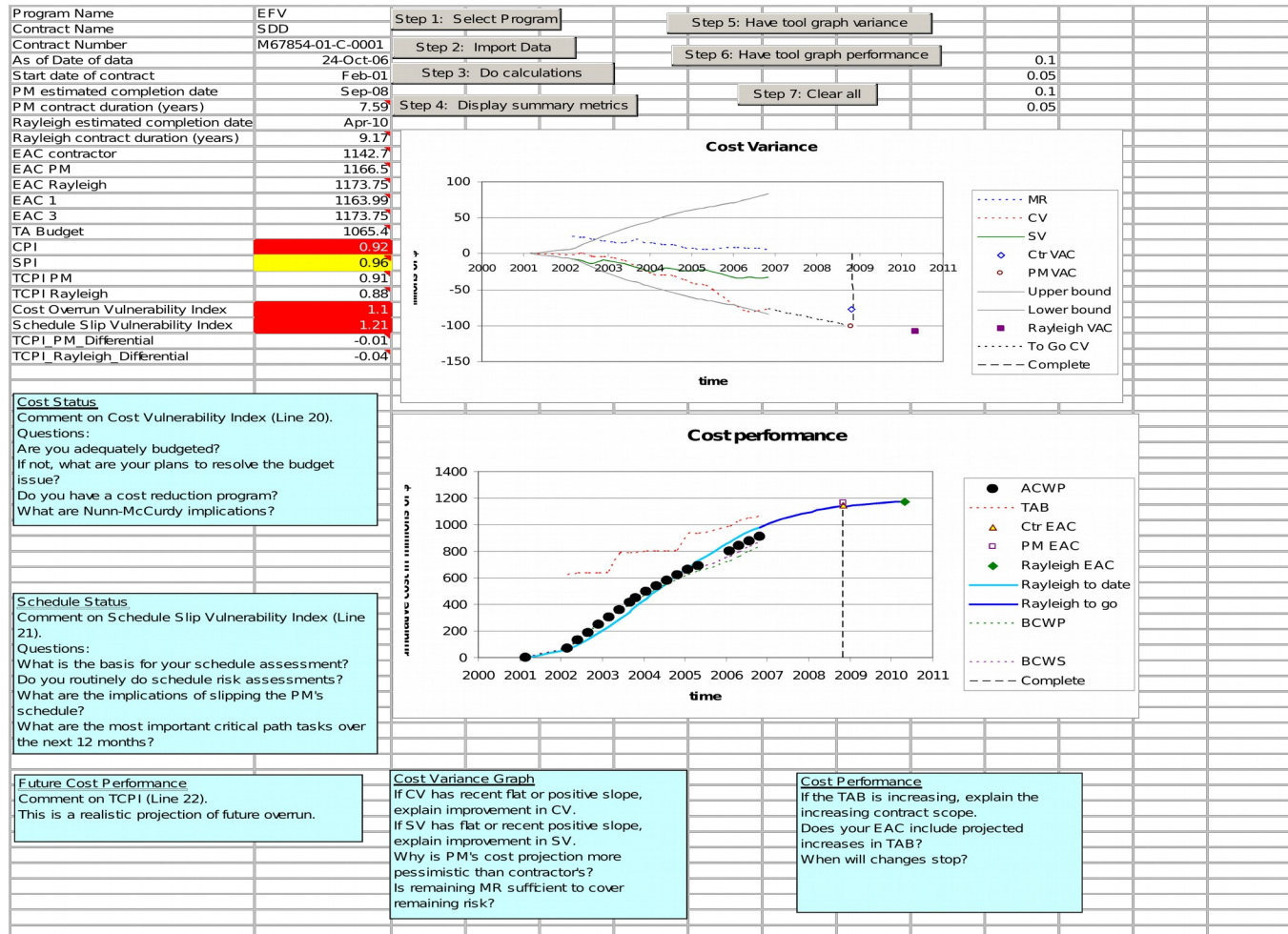
- Plan Validity Index
- “What if” drills

XCasa advantages

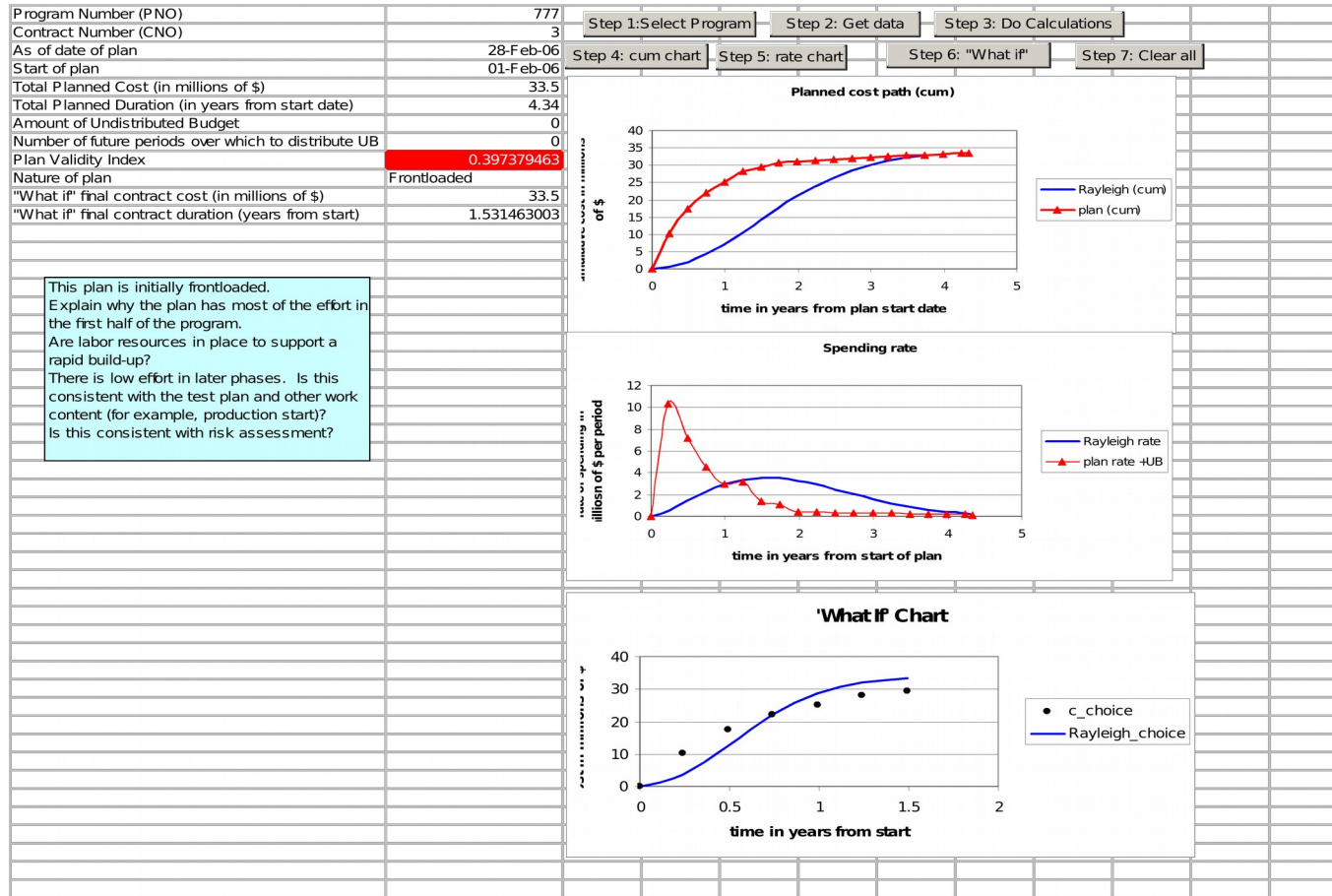


- User friendly
- Interactive
- Provides useful information early in life of contract
- Uses built-in Solver add-in with widely used Excel spreadsheet software
- Provides business insights

Dashboard view of XCAM



Dashboard view of XPAM



XPAM Advantages



- Only XPAM can assess the initial plan
 - Current EVM diagnostics cannot assess the the plan until after submission of some number of full EVM data
 - Often more than a year after contract start

XCaSA Tool Status



- Tested XCAM with multiple current programs
- Tested XPAM with notional initial program management baselines

Potential Impact



- Improve oversight of programs
- Obtain early assessments of plan and contract execution
- Make better informed tradeoff decisions
- Make EVM tool of choice across the government

Potential Future Studies



- Investigate use of the model with program level budget data
- Apply model to procurement contracts
- Upgrade tools with user feedback
 - Open source management of tool
- Develop Monte Carlo policy simulation package with Rayleigh spline for tool
- Upgrade “insight” prompts in tool

Recommendations



- Require Rayleigh EAC and estimate of duration time for R&D contracts
 - Lower estimates must be explained
- Fund XCAM upgrades
 - upgrade insight aspect of tool
 - Examine the “missing” 30% of EACs
 - Evaluate use with program level budget data
 - Upgrade code functionality and user interface
- Fund study of indicators of a reliable contractor EVM system

Conclusions



- Questions/Comments